

The Algorithm A in Detail

S. Subramanian

17-03-2021

PT Training

1

Where to find details?

- ❑ **ISO 5725-5:1998, clause 6.2**
- ❑ **ISO 13528:2015, ANNEXURE E3**

17-03-2021

PT Training

2

The data

- We denote the p items of data, sorted into increasing order, by: $x_1, x_2, \dots, x_p \dots x_p$
- and the robust average and robust standard deviation by x^* and s^*

Example (from ISO 5725-5, table 26):

x_i	
17,570	
19,500	
20,100	
20,155	
20,300	
20,705	
20,940	
21,185	
24,140	
	arithm. mean: 20,511
	standard deviation: 1,727

17-03-2021

Basimaster / Koch: Algorithm A – PT training course, 4th April 2011, New Delhi

AQS Baden-Württemberg

Initial values for x^* and s^*

- As initial value for x^* we take the median
- As initial value for s^* we calculate the MAD

$$s^* = 1.483 \times \text{med}[x_i - x^*]$$

Example:

x_i	$ x_i - x^* $	$ x_i - x^* $ (sorted)
17,570	2,730	0,000
19,500	0,800	0,145
20,100	0,200	0,200
20,155	0,145	0,405
$x^* \rightarrow 20,300$	0,000	0,640
20,705	0,405	0,800
20,940	0,640	0,885
21,185	0,885	2,730
24,140	3,840	3,840

$$\text{med}[x_i - x^*] = 0,640$$

$$s^* = 1.483 \times 0,640 = 0,949$$

Baummeister / Koch: Algorithm A – PT training course, 4th-8th April 2011, New Delhi

Updating of x^* and s^*

- We calculate a limit $\delta = 1.5 \times s^*$
- and change all data x_i

$$x'_i = \begin{cases} x^* - \delta & \text{if } x_i < x^* - \delta \\ x_i & \text{if } x_i > x^* + \delta \\ x_i & \text{otherwise} \end{cases}$$
- From these data we calculate the arithm. mean as new x^* and the standard dev. with a correction factor as new s^*

$$s^* = 1.134 \times \sqrt{\frac{\sum (x'_i - x^*)^2}{p-1}}$$

Example:

$$\delta = 1.5 \times 0,949 = 1,424$$

$$x^* - \delta = 20,300 - 1,424 = 18,876$$

$$x^* + \delta = 20,300 + 1,424 = 21,724$$

x_i	x^*
17,570	18,876
19,500	19,500
20,100	20,100
20,155	20,155
20,300	20,300
20,705	20,705
20,940	20,940
21,185	21,185
24,140	21,724

new $x^* = 20,387$
new $s^* = 0,985$

Baummeister / Koch: Algorithm A – PT training course, 4th-8th April 2011, New Delhi

Iteration

- ✓ With the new x^* and s^* we calculate a new limit δ
- ✓ We apply this new limit again on the original data and calculate a new x^* and s^*
- ✓ We repeat this procedure until the process converges

17-03-2021 PT Training

Iteration example

Iteration	0	1	2	3	4
δ		1,424	1,478	1,514	1,539
$x^* - \delta$		18,876	18,909	18,893	18,872
$x^* + \delta$		21,724	21,865	21,921	21,950
x_1^*	17,570	18,876	18,909	18,893	18,872
x_2^*	19,500	19,500	19,500	19,500	19,500
x_3^*	20,100	20,100	20,100	20,100	20,100
x_4^*	20,155	20,155	20,155	20,155	20,155
x_5^*	20,300	20,300	20,300	20,300	20,300
x_6^*	20,705	20,705	20,705	20,705	20,705
x_7^*	20,940	20,940	20,940	20,940	20,940
x_8^*	21,185	21,185	21,185	21,185	21,185
x_9^*	24,140	21,724	21,865	21,921	21,950
new x^*	20,300	20,387	20,407	20,411	20,412
new s^*	0,949	0,985	1,009	1,026	1,039

17-03-2021 PT Training 7
